

Accumulator Injection Channel and Aperture

December 05 Study Period

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Abstract

Documentation of Accumulator Injection Region work during the December 05 Study Period, specifically settings of the injection kicker and septa for reverse protons, injection orbit, and aperture.

1 Study Shifts

The following shifts were spent investigating the Accumulator injection region:

- Owl, Wed 23 Nov, Pbar E-log entry 676. Mainly Reverse proton TBT in Debuncher, some work on Injection orbit aperture
- Owl, Sat 26 Nov, Pbar E-log entry 684. Injection orbit aperture
- Owl, Sun 27 Nov, Pbar E-log entry 687. Injection kicker settings to transfer 7 π beam through injection septum
- Owl, Tue 29 Nov, Pbar E-log entry 692. Built vertical bump at Injection septum to help with D/A quad centering

The initial injection orbit aperture was measured to be 5.64 π horizontally and 8.1 π vertically. Bumping the beam inward at A1Q4 improved the horizontal aperture. The bump was put in on the 27 Nov owl (measured aperture of 6.2 π horizontally and 8.7 π vertically) and left through the remainder of the study period.

2 Setting of Kicker and Septa

With the A1Q4 horizontal bump in place, two scans of the kicker voltage were done. One was to determine the setting necessary to clear injected reverse proton beam. The second was to determine the scale of volts to mm at the septum.

Injected reverse proton beam from the Main Injector had a 95% horizontal emittance of 3 π (based on both scraper scans and the 300 MHz emittance monitor measurements). 100% of the beam was contained in 5.5 π . Looking at a loss monitor near the injection septum (A:LM1Q3), 50 kV on A:IKIK is necessary to have 3 π 95% clear the injection septum (see figure 1).

By using a spectrum analyzer in zero span mode, the beam remaining in the Accumulator as a function of kicker voltage was measured. Starting from 0 kV on the kicker, the voltage

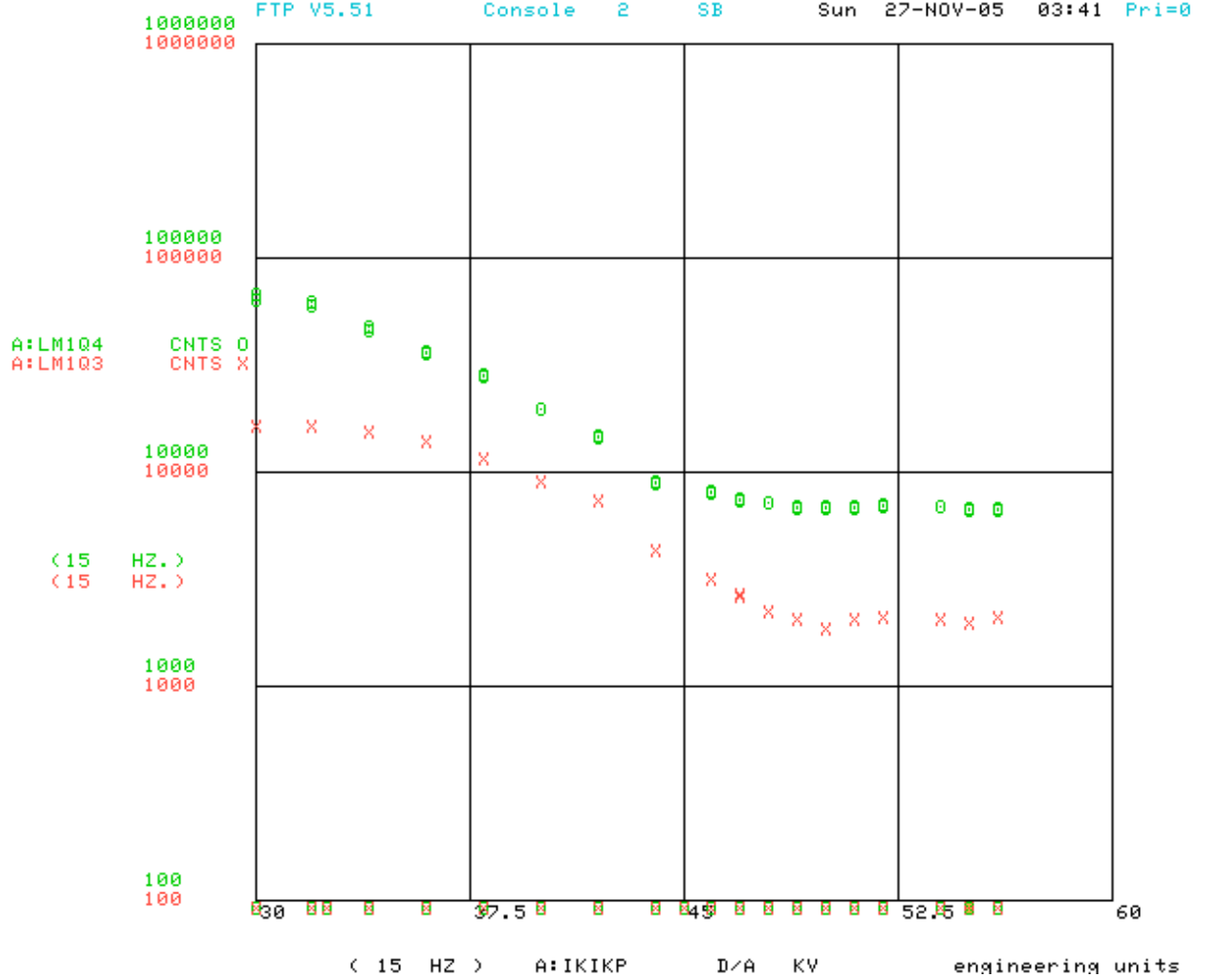


Figure 1: Loss monitor counts at A1Q4 and A1Q3 as a function of the injection kicker setting. Reverse proton beam averaged 3π during this period. 50 kV is necessary for 3π beam to clear the septum D channel.

was increased in 2.5 kV steps. At 0 kV, all the beam remained circulating in the Accumulator. The first setting where the remaining beam was less than 100% was at 12.5 kV, where the value was down by 30%. At 27.5 kV, the value was 0.1% and by 32.5 kV it was at the noise floor of the spectrum analyzer. A value of 18 kV was chosen as necessary for the 5.46π (100%) to be completely removed (see figure 2. Therefore, $20.4\text{ kV} (=18 \times \sqrt{\frac{7}{5.46}})$ would be necessary for 7π beam.

With the 50 kV for 5.5π beam to clear, an additional 1.2 kV is necessary for 7π to clear (half of the difference between 20.4 and 18 kV), resulting in a setting of $A:IKIKP = 51.2\text{ kV}$. The nominal setting before the study period was 53 kV.

Injection septa voltages were adjusted to minimize horizontal steering by Q807. For reverse protons, a value of 665.5 minimized steering.

3 Orbit measurements

The nominal injection orbit was changed with the A1Q4 bump. Archive file 17 was saved on 26 Nov and protected. This file is the nominal injection orbit. Note that this bump probably

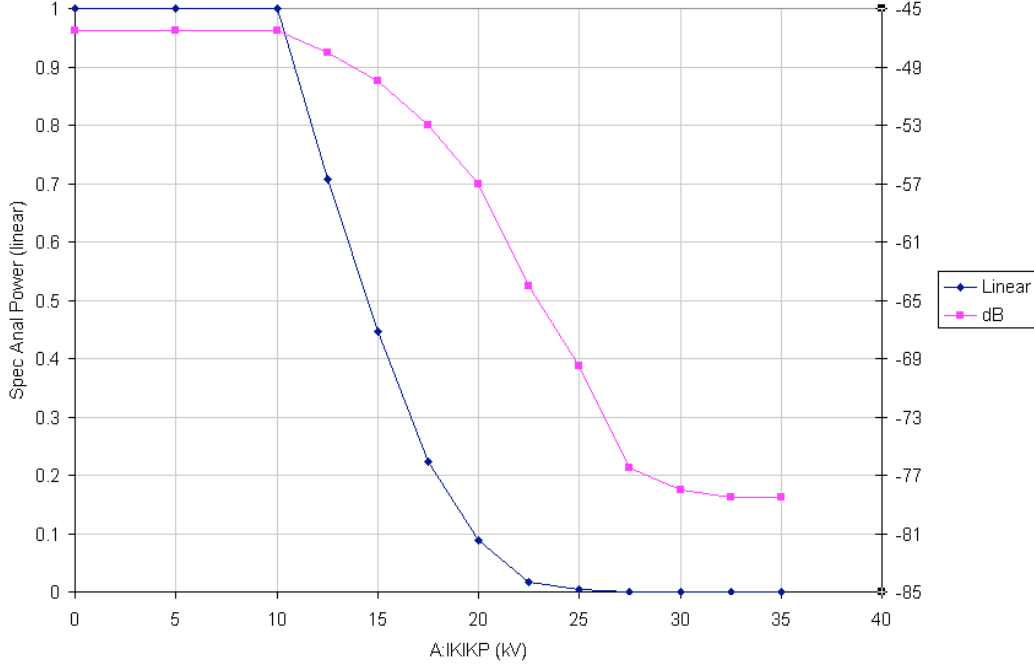


Figure 2: Fraction of the beam remaining (based on spectrum analyzer in zero span) as a function of the kicker voltage. 18 kV was chosen as the value to completely move the beam past the septum channel.

changes the nominal central and core orbits as well and those changes should be investigated (dispersion is small but not zero in this area of the Accumulator).

4 Conclusions

With the setting of A:IKIK at 51.2 kV and running the A1Q4 bump, it is possible to deliver 7 π reverse proton beam to the Accumulator septa. Additional changes to the septa voltages and a vertical bump at the septa allowed for centering reverse proton beam to Q807.